

NON-PUBLIC?: N  
ACCESSION #: 9311160317  
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Beaver Valley Power Station Unit 1 PAGE: 1 OF 08

DOCKET NUMBER: 05000334

TITLE: Unit 1 Reactor Trip and Required Shutdown, Dual Unit Loss  
of Offsite Power.  
EVENT DATE: 10/12/93 LER #: 93-013-00 REPORT DATE: 11/11/93

OTHER FACILITIES INVOLVED: Beaver Valley Unit 2 DOCKET NO: 05000412

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR  
SECTION:  
50.73(a)(2)(i) & 50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:  
NAME: L. R. Freeland, General Manager TELEPHONE: (412) 643-1258  
Nuclear Operations

COMPONENT FAILURE DESCRIPTION:  
CAUSE: A SYSTEM: FK COMPONENT: XXX MANUFACTURER: XXX  
B AB XXX XXX  
REPORTABLE NPRDS: N  
N

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On 10/12/93 Unit 1 was operating at 100 percent power and Unit 2 was in a refueling outage with all fuel removed from the reactor vessel. At 1507 hours, Unit 1 experienced a large loss of offsite load when ten offsite feed breakers in the Beaver Valley switchyard opened as a result of an inadvertent underfrequency system separation actuation. The load reduction caused the Unit 1 turbine to trip on mechanical overspeed and resulted in a High Flux Rate Reactor Trip. The opening of the switchyard feed breakers and the resultant Unit 1 generator trip resulted in a loss of offsite power to Units 1 and 2. Both Unit 1 Emergency Diesel Generators (EDGs), and the required Unit 2 EDG, started and supplied their required loads. Unit 1 Auxiliary Feedwater actuated due to Low-Low Steam Generator Levels resulting from the Reactor Trip. Unit 1 was

stabilized using the Emergency Operating Procedures. Following realignment of switchyard breakers, offsite power was restored to both units by 1522 hours. On 10/13/93, following a Unit 1 containment inspection, a Reactor Coolant System Pressure Boundary Leak was discovered on the Loop 1A cold leg vent valve RC-27. A Technical Specification Required cooldown was initiated and Mode 5 was entered at 0304 hours on 10/14/93.

END OF ABSTRACT

Table "Required Number Of Digits/Characters For Each Block" omitted.

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#### DESCRIPTION OF EVENT

On October 12, 1993 Beaver Valley Unit 1 was operating at 100 percent power with normal station loads being supplied from the unit station service transformers. Unit 2 was in the Fourth Refueling Outage with all of the fuel removed from the reactor vessel and stored in the spent fuel pool. Required Unit 2 electrical loads were being supplied from offsite power via backfeed through the main unit transformer. Power was also available to Unit 2 via the 2A system station service transformer. The 2B system station service transformer was removed from service for maintenance.

At 1507 hours, Unit 1 experienced a loss of the majority of its electrical load when ten offsite feed breakers in the Beaver Valley switchyard opened unexpectedly. The loss of these offsite breakers, which included the in-service Beaver Valley Unit 2 main output breaker (PCB 362) and one Unit 1 output breaker (PCB 341), caused Unit 1 generator load to drop from approximately 810 net MWe to 85 net MWe. The loss of load caused the turbine speed to increase until the turbine tripped on mechanical overspeed (setpoint 1998 rpm). The Turbine Overspeed Protection (OPC) trip actuation operated but was not required since the turbine had already tripped on mechanical overspeed. Historical computer data from the event indicated turbine peak speed at 2051 rpm. The increased turbine speed caused an increase in generator output frequency forcing a corresponding increase in the Reactor Coolant Pump (RCP) speed. A transient Reactor Coolant System flow increase resulted from the RCP speed change. This flow transient translated into a positive reactivity change leading to a High Flux Rate Reactor Trip. All Control Rods inserted fully.

Following the Unit 1 Reactor Trip, the No. 1 Emergency Diesel Generator (EDG) auto-started, due to Train A Emergency 4KV bus (AE) undervoltage; however, the undervoltage condition was not sufficient to require the AE bus to shed its loads and cause EDG sequencing. All three Auxiliary

Feedwater (AFW) Pumps (two motor driven and one steam driven) auto-started due to the shrink in steam generator levels. All three Reactor Coolant Pumps tripped on bus underfrequency as the Main Unit Generator speed reduced. Thirty seconds following the turbine trip the generator output breakers opened as designed. The Unit 1 Main Unit Generator had been the only normal power source for Unit 1 and Unit 2 electrical loads since the underfrequency separation scheme actuated. When the Unit 1 generator tripped, Unit 1 and 2 both experienced a loss of offsite power.

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Following the loss of offsite power, Unit 1 normal 4KV busses de-energized and shed their loads, and the Unit 1 No. 2 EDG started. Both Unit 1 EDGs then properly sequenced loads on their respective busses as designed, including charging, river water, component cooling, and AFW pumps. Unit 1 operators stabilized the plant using the Emergency Operating Procedures (EOPs). Initially, a natural circulation cooldown was established as no power was available for the Reactor Coolant pumps. The Main Steamline Isolation Valves were closed manually, in accordance with Emergency Operating Procedure E-0, as there was no position indication available for the Reheater Steam Supply Isolation Valves during the loss of offsite power. Operators then utilized Steam Generator Atmospheric Steam Release Valves to remove decay heat and control the cooldown. At 1517 hours, the Duquesne Light Company System Operations Department restored offsite power by re-closing the switchyard breakers. The Unit 1 control room crew then established forced Reactor Coolant System cooling by starting Reactor Coolant Pump 1C. The AE and DF emergency busses were realigned to offsite power and the EDGs were secured.

At the initiation of the event at Unit 2 (prior to the loss of offsite power) the standby Primary Component Cooling Water Pump (2CCP-P21C) auto-started on low header pressure, the Unit 2, 2-1 Emergency Diesel Generator (EDG) started on degraded bus voltage, and the 2A and 2B normal 4KV busses transferred to offsite power. The dual unit Control Room Emergency Pressurization System actuated due to a loss of voltage to the Control Room Area Radiation Monitor 2RMC-RQ201. Following the Unit 1 main unit generator trip and the resultant loss of offsite power, the Unit 2, Train A emergency 4KV bus (2AE) shed its loads and the Unit 2, 2-1 EDG properly sequenced all available loads. Low Head Safety Injection Pump 2SIS-P21A auto-started via the EDG sequencer as designed, but no water was injected since the discharge valves were closed for refueling. The pump was secured eighty-four seconds after it started. The Unit 2 Train B emergency 4KV bus (2DF) and associated 2-2 EDG had been removed from service for outage related maintenance and were not required to be operable. Following restoration of offsite power at Unit 2 (1522 hours), the 4KV system was reenergized and the Train A normal to emergency 4KV tie

breakers were closed. The Unit 2, 2-1 EDG was unloaded and output breaker opened at 1535 hours.

Following the Reactor Trip, Unit 1 was in Hot Standby, Mode 3. At 0345 hours, on October 13, 1993, a Unit 1 containment entry was made to perform routine, post trip, leak inspections. During this inspection, a leak was identified at the Loop 1A Cold Leg Vent Valve (RC-27). This valve is also used as a connection point for disc pressurization for isolating the 1A reactor coolant loop. A subsequent entry was made to perform more detailed inspections. A review of photographs and discussion by Mechanical Maintenance and Operations, led to the conclusion that potential Pressure Boundary Leakage existed.

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Unit 1 then commenced a cooldown to Cold Shutdown per Technical Specification 3.4.6.2.a, and declared an Unusual Event per the Emergency Preparedness Plan. Unit 1 entered Mode 5 at 0304 hours on October 14, 1993 and the Unusual Event was terminated at that time. Upon inspection, RC-27 was found to have a through-wall crack at the fillet weld, verifying Pressure Boundary Leakage.

#### CAUSE OF EVENT

The cause of the loss of offsite power event was personnel error. A three man Electrical maintenance crew, consisting of a Crew Leader, an Electrical Maintenance Technician, and a Senior Engineer, were performing scheduled outage maintenance on Unit 2 Main output Breaker PCB 352. During the verification of auxiliary contact alignment of the PCB 352 breaker, an inadvertent application of 125 Volt DC actuated an underfrequency separation scheme in the Beaver Valley switchyard. This resulted in the opening of seven 345 KV feed breakers (including Unit 1 Main Unit Output Breaker PCB 341) and three 138 KV feed breakers, initiating the loss of electrical load at Unit 1.

A cracked mechanical linkage, for the center stack auxiliary contacts of breaker PCB 352, was replaced the morning of October 12, 1993. At 1400 hours, during timing tests of the breaker's mechanism, the Beaver Valley Relay Group Supervisor notified the maintenance crew that reset relays associated with PCB 352, located in the Unit 2 Relay Room, were overheating. It was determined that the auxiliary contacts, located in the center stack of a three stack assembly, were in the wrong position. This caused the operate and reset coils of the reset relays in the relay room to be energized simultaneously, resulting in overheating. The maintenance crew then visually checked the auxiliary contacts of PCB 352 on the stack

where the cracked arm was replaced. They determined that the stack's shaft was rotated out of position. The problem was corrected and the auxiliary contact linkage reassembled. Using a multimeter on continuity scale and site electrical prints, the crew then started checking the three auxiliary contacts connected to this linkage for other possible misalignment problems. During this verification, underfrequency tripping relays were actuated when 125 Volt DC from one set of contacts was inadvertently connected to another set of contacts in the underfrequency separation scheme, via the multimeter.

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The cause of the Unit 1 Pressure Boundary Leak was determined to be due to a fillet weld failure. Samples of pipe removed from RC-27 were sent to a laboratory for failure analysis. The results indicated that the weld failed due to the presence of an imbedded flaw that propagated inward and outward, causing a through-wall crack. RC-27 was inspected during the last refueling outage (9R) in response to a vendor recommendation concerning disc pressurization line socket weld cracking. A linear indication was found at that time and was believed to have been satisfactorily repaired. A minor design change was also implemented in 9R to reduce the pipe length, thereby reducing the probability of pipe failure due to cyclic loads.

#### CORRECTIVE ACTIONS

The following corrective actions have been initiated as a result of the event:

1. Detailed root cause analyses were performed to determine the cause of the switchyard transient and Reactor Coolant System leak.
2. Interim administrative controls over work performed in the Beaver Valley switchyard were issued that require Operations Department approval of all work activities in the switchyard.
3. Long term administrative controls governing work in the switchyard will be established by the managers responsible for switchyard activities.
4. The Underfrequency System Separation scheme in the Beaver Valley switchyard has been disabled. At the time the separation scheme was implemented, there was sufficient electrical load available in the local vicinity to maintain Beaver Valley Unit 1 on-line and separated from the rest of the system. As a result of load changes, this separation scheme is no longer valid.

5. Unit 1 Loop 1A Cold Leg Vent Valve (disc pressurization connection) C-27 was removed, plugged, capped, and welded. All other disc pressurization taps penetrating loop stop valves were inspected at both Beaver Valley units and found to be satisfactory. Samples removed from RC-27 indicate that the failure was due to an imbedded flaw. Further evaluation will be performed to determine the need for additional corrective actions.

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## REPORTABILITY

Beaver Valley Units 1 and 2 reported the Reactor Trip and Dual Unit Loss of Offsite Power to the Nuclear Regulatory Commission, via the Emergency Notification System, at 1843 hrs on October 12, 1993, and Unit 1 reported the Unusual Event at 0811 hours on October 13, 1993. The Unit 1 Reactor Trip and Dual Unit Loss of Offsite Power were reported in accordance with 10 CFR 50.72.b.2.ii. (Reactor Protection System and Engineered Safety Feature Actuations) and the Unit 1 Unusual Event was reported in accordance with the Emergency Preparedness Plan and 10 CFR 50.72.b.1.i.A. (Technical Specification Required Shutdown). This written report is being submitted in accordance with 10 CFR 50.73.a.2.iv. and 10 CFR 50.73.a.2.i.

## SAFETY IMPLICATIONS

There were minimal safety implications at Units 1 or 2 as a result of this event. At Unit 1 the Reactor Protection System functioned as designed and actuated a reactor trip. The operating crew successfully stabilized the plant following the reactor trip using the Emergency Operating Procedures. Normal post-trip evaluations were performed and all ESF equipment was determined to have functioned as designed. The event is bounded by the following Updated Final Safety Analysis (UFSAR) Sections and plant response was deemed to be within the analysis results and conclusions: 14.1.7 (Loss of External Electrical Load and/or Turbine Trip), 14.1.8 (Loss of Normal Feedwater), 14.1.11 (Loss of Offsite Power to the Station Auxiliaries (Station Blackout)), 14.1.12 (Turbine - Generator Accidents), and 14.2.9 (Complete Loss of Forced Coolant Flow).

Unit 2 was in a Refueling Outage with all of the fuel removed from the reactor vessel and stored in the spent fuel pool. The 2-2 Emergency Diesel Generator (EDG) and the Train B emergency 4KV bus were on clearance. On the loss of off-site power all required Train A station loads were properly sequenced by the 2-1 EDG. At Unit 2 the event was bounded by UFSAR Section 15.2.6 (Loss of Nonemergency AC Power to the Plant Auxiliaries (Loss of Offsite Power)).

There were also minimal safety implications to the public as a result of the Reactor Coolant Pressure Boundary leakage. All leakage was contained inside the Containment Building. Recent Reactor Coolant System Water Inventory Balance Tests, prior to the event, had shown unidentified leakage at less than 0.1 gpm. This event was bounded by Unit 1 UFSAR Section 14.3.1 (Loss of Reactor Coolant From Small Ruptured Pipes or From Cracks in Large Pipes Which Actuates Emergency Core Cooling System). Emergency Core Cooling was not actuated for this event.

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## DIESEL GENERATOR RELIABILITY

Both Unit 1 emergency diesel generators and the operable Unit 2 emergency diesel generator, properly started and sequenced all available loads at the proper times as designed for a loss of offsite power. The following is a summary of the past 20, 50 and 100 start and load demands for Unit 1 and 2 emergency diesel generators, trended in accordance with NUMARC 87-00 Rev. 1, Appendix D (Data as of September 30, 1993):

Number of Valid Failures

Reliability =  $1 - \text{Number of Valid Demands}$

### Unit 1

Past 20 Start Demands:  $1 = 1 - 0/20$

Past 50 Start Demands:  $1 = 1 - 0/50$

Past 100 Start Demands:  $1 = 1 - 0/100$

Past 20 Load Demands:  $1 = 1 - 0/20$

Past 50 Load Demands:  $1 = 1 - 0/50$

Past 100 Load Demands:  $0.99 = 1 - 1/100$

### Unit 2

Past 20 Start Demands:  $1 = 1 - 0/20$

Past 50 Start Demands:  $1 = 1 - 0/50$

Past 100 Start Demands:  $1 = 1 - 0/100$

Past 20 Load Demands:  $1 = 1 - 0/20$

Past 50 Load Demands:  $1 = 1 - 0/50$

Past 100 Load Demands:  $1 = 1 - 0/100$

Note: Subsequent to this summary, Unit 2 experienced relay failures on both diesel generators, which are not listed above, but would have prevented sequencer loading on a safety injection signal. These will be

reported in a subsequent Unit 2 Licensee Event Report on the diesel generator failures.

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#### PREVIOUS SIMILAR EVENTS

No similar events have previously occurred at Beaver Valley Units 1 and 2 involving a reactor trip and loss of offsite power.

Unit 1 has previously reported two events involving a required plant shutdown due to Reactor Coolant System (RCS) Pressure Boundary leakage:

1. LER 1-88-016 "Unit Shutdown Due to Pressure Boundary LER Leakage." This event involved a failed weld on the line near an RCS seal injection drain valve.

2. LER 1-91-002 "Reactor Coolant System Pressure Boundary Leakage Results in Plant Shutdown. This event involved the failure of a socket weld on the Loop 1B Cold Leg Vent Valve (disc pressurization connection).

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November 11, 1993  
ND3MNO:3505

Beaver Valley Power  
Station, Unit No. 1  
Docket No. 50-334, Licensee No. DPR-66  
LER 93-013-00

United States Nuclear Regulatory Commission  
Document Control Desk  
Washington, DC 20555

Gentlemen:

In accordance with Appendix A, Beaver Valley Technical Specifications, the following Licensee Event Report is submitted:



LER 93-013-00, 10 CFR 50.73.a.2.i and 10CFR50.73.a.2.iv, "Unit 1  
Reactor Trip and Required Shutdown, Dual Unit Loss of Offsite Power."

L. R. Freeland  
General Manager  
Nuclear Operations

JWM/ke

Attachment

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Page 2

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